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Blarina carolinensis.

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Blarina carolinensis (Bachman, 1837)

Southern Short-tailed Shrew

Sorex carolinensis Bachman, 1837:368–369. Type locality "upper and maritime districts of South Carolina," subsequently restricted to Charleston County by Handley and Varn (1994).
Blarina carolinensis Baird, 1859:45. First use of present name combination.
Blarina brevicauda carolinensis Merriam, 1895:13. Type locality "eastern South Carolina."

CONTEXT AND CONTENT. Order Insectivora, family Soricidae, subfamily Soricinae, tribe Blarinini (Repenning 1967). The genus *Blarina* includes 3 species restricted to North America: *B. brevicauda, B. carolinensis,* and *B. hylophaga.* Four subspecies are recognized:

B. c. carolinensis Bachman, 1837:368–369, see above.
B. c. minima Lowery, 1943:218. Type locality "Comite River, 13 mi. NE Baton Rouge Parish, Louisiana."
B. c. peninsulae Merriam, 1895:14. Type locality "Miami River, Dade county, Florida."
B. c. shermani Hamilton, 1955:37. Type locality "two miles north of Fort Myers, Lee County, Florida."

The karyotype of *B. c. peninsulae* suggests it is a distinct species (Genoways and Choate 1998; George et al. 1982). Furthermore, *B. c. shermani* is more similar in body size to *B. brevicauda* than *B. carolinensis* (Hamilton 1955). Because *B. c. shermani* is only known from the type locality and may be extinct (Layne 1992), it is sometimes not included in accounts of the species (Genoways and Benedict 1999).

DIAGNOSIS. *Blarina carolinensis* (Fig. 1) is the smallest of 3 species within the genus *Blarina* (Genoways and Choate 1972; George et al. 1981; Tate et al. 1980). Adult *B. carolinensis* usually can be distinguished from congenerics by an occipito-premaxillary length <20.0 mm and cranial breadth <11.5 mm (Fig. 2; George et al. 1981; Hoffmeister 1989 Tate et al. 1980). Length of head and body in *B. carolinensis* generally is <81 mm, whereas that of *B. brevicauda* generally is >81 mm (Hoffmeister 1989). *B. carolinensis* typically weighs <13.5 g and has a length of hind foot <13 mm (Hoffmeister 1989). If *B. c. shermani* is a subspecies of *B. carolinensis,* it is not distinctly smaller than *B. brevicauda* (Hamilton 1955).

FIG. 1. *Blarina carolinensis* captured in Jackson County, Illinois (used with permission of Michael Redmer©/COLEPhoto).

Dentary (Fig. 2) of *B. carolinensis* differs from that of *B. brevicauda* in that height of coronoid process typically is ≤6 mm and length of mandibular toothrow typically is ≤6.5 mm (Carraway 1995). Also, mental foramen of *B. brevicauda* is directly beneath hypoconid of m1, whereas mental foramen of *B. carolinensis* is farther forward, under midpoint between protoconid and hypoconid. Although dentaries of *B. carolinensis* and *B. hylophaga* are similar in size, i1 of *B. carolinensis* is more procumbent and set at an angle ≤17° from horizontal ramus of dentary (Carraway 1995).

Karyotype of *B. carolinensis* also is distinct (George et al. 1982), though quite variable. Except for *B. c. peninsulae,* diploid numbers (2n = 31–46) are less than those for *B. brevicauda* (48–50) or *B. hylophaga* (52), and fundamental numbers (FN = 41–45) are also less than those of *B. brevicauda* (48) or *B. hylophaga* (60–62). Karyotype of *B. c. peninsulae* (2n = 50–52, FN = 52) is

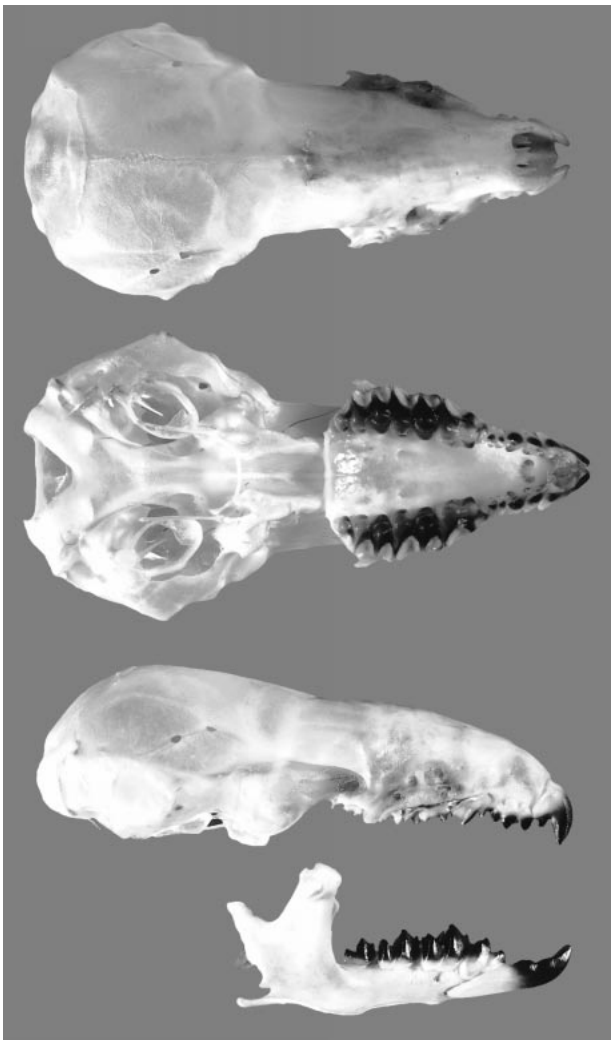

FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Blarina carolinensis* (ASU [Appalachian State University] 18589) from Mecklenburg County, North Carolina. Greatest length of skull is 20.0 mm. Photographs by Warren Wheeler.

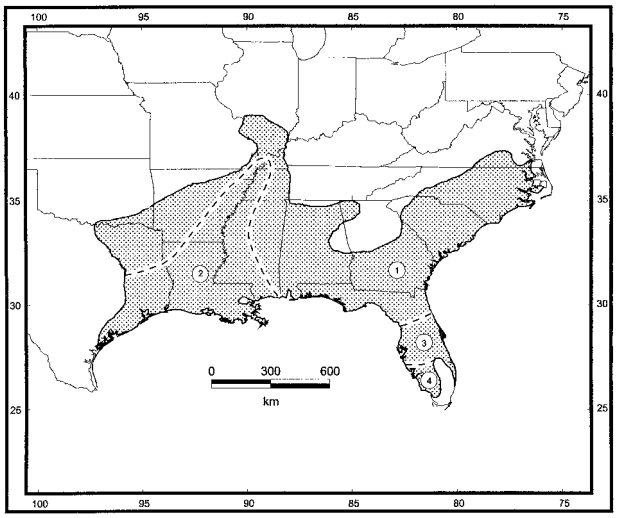

FIG. 3. Geographic distribution of *Blarina carolinensis*: 1, *B. c. carolinensis*; 2, *B. c. minima*; 3, *B. c. peninsulae*; 4, *B. c. shermani*. Map redrawn from Hall (1981) and modified according to French (1981), George et al. (1982), Layne (1992), Schmidley (1983), and Tate et al. (1980). Distributions of *B. c. minima* and *B. c. carolinensis* in western portion of the range are uncertain (Genoways and Choate 1998).

distinct and markedly different from that of other *B. carolinensis* (George et al. 1982). *B. carolinensis* from southern Illinois (n = 58) had a fixed allele at the mannose-6-phosphate isomerase locus that differed from that of *B. brevicauda* in Tennessee and Kentucky (n = 83—Driskell 1992).

GENERAL CHARACTERS. *Blarina carolinensis* is a medium-sized, robust shrew with short legs. It has a robust cervical region that, along with narrow shoulders and hips, effects a fusiform body shape. Tail is short, hairy, faintly bicolored, and slightly flattened dorsoventrally (Audubon and Bachman 1851). *B. carolinensis* has inconspicuous eyes and pinnae (George et al. 1986). Its rostrum is relatively pointed and well-furred, with long white vibrissae (Audubon and Bachman 1851). Pelage is slate gray throughout, though slightly lighter on venter than on dorsum. Feet are pentadactyl, relatively robust, and reflect fossorial habits. Hind feet are darker than fore feet, and claws are sharp and slightly curved (Audubon and Bachman 1851).

Means (mm; — = no data) and ranges (in parentheses) for selected external and cranial measurements from Alexander and Union counties, Illinois (n = 35—Hoffmeister 1989); Louisiana (Lowery 1974); Charleston County, South Carolina (Handley and Varn 1994); Ballard and Fulton counties, Kentucky (Rippy 1967); and Alachua and Putnam counties, Florida (n = 17—Hamilton 1955), respectively, are as follows: total length, 88.0 (77–98); 85.0 (72–95) n = 73; 102.0 (99–105) n = 2; 98.0 (90–105) n = 9; 92.2 (84–102); length of tail, 18.4 (12–25); 17.8 (13–23) n = 73; 20.0 (15–23) n = 8; —; 21.0 (18–26); length of hind foot, 11.7 (10–15); 12.0 (10–14) n = 73; 12.4 (12–13) n = 8; 12.0 (12–12) n = 9; 12.5 (11–14); occipito-premaxillary length, 19.0 (18–20); —; —; —; —; condylobasal length, —; —; 19.0 (18–19) n = 7; 18.6 (18.4–18.9) n = 7; 19.3 (18–20); and cranial breadth, 10.4 (10.0–10.8); 9.7 (9.1–10.6) n = 75; 10.4 (10.1–10.7) n = 7; 10.4 (10.2–10.6) n = 6; 10.3 (9.7–10.8).

DISTRIBUTION. *Blarina carolinensis* ranges (Fig. 3) from coastal and south-central Virginia (Pagels and French 1987; Tate et al. 1980; Webster et al. 1985) through the Outer Banks, Coastal Plain, and Piedmont of North Carolina (French 1981; Lee et al. 1982; Webster 1988, 1996; Webster et al. 1985) and South Carolina (French 1981; Golley 1966; Mengak et al. 1987; Sanders 1978; Webster et al. 1985). In Georgia, *B. carolinensis* occurs throughout the Coastal Plain and in the northwestern portion of the state (French 1981; Laerm et al. 1981). The southern short-tailed shrew occurs throughout Florida except in the central Everglades area (French 1981; Layne 1992; Sherman 1937) and in all but the Piedmont of east-central Alabama (French 1981; Howell 1921; Linzey 1970). It occurs throughout Mississippi (Jones and Carter 1989; Kennedy et al. 1974), in the western one-third of Tennessee (Braun and Kennedy 1983; Calhoun 1941; Decker et al. 1989; French 1981; Kennedy 1991), and west of the Tennessee River in Kentucky (Bryan 1991; Rose and Seegert 1982).

Blarina carolinensis ranges throughout Louisiana (Lowery 1943, 1974) and reaches its westernmost extent in the easternmost quarter of Texas (George et al. 1981; McCarley 1959; Schmidley 1983; Schmidley and Brown 1979), with an apparently disjunct population in Bastrop County (Baumgardner et al. 1992). It occurs in the extreme southeastern corner of Oklahoma (George et al. 1981) and in the southeastern two-thirds of Arkansas (Garland and Heidt 1989; George et al. 1981; Tumlinson et al. 1992). Finally, *B. carolinensis* occurs in extreme eastern Missouri (Easterla 1968; George et al. 1981) and southern Illinois (Ellis et al. 1978; Gerard and Feldhamer 1990; Hoffmeister 1989; Layne 1958). It has not been collected from Indiana but, based on its distribution in Illinois, may inhabit the extreme southwestern portion of the state (Mumford and Whitaker 1982).

Blarina carolinensis increases in size from south to north in Texas, suggesting that both *B. c. carolinensis* and *B. c. minima* live in the state (Schmidley and Brown 1979). Both subspecies may occur in Arkansas (Ramsey 1977). However, many individuals attributed to *B. c. carolinensis* in Arkansas may have been *B. hylophaga* (George et al. 1981). Thus, evidence for *B. c. carolinensis* in Arkansas is tenuous. The range for *B. c. minima* may encompass eastern Texas, the southeastern two-thirds of Arkansas, southeastern Oklahoma, and southeastern Missouri (Genoways and Benedict 1999). The range of *B. c. peninsulae* is restricted to peninsular Florida, with a northernmost limit between Highland and Leon counties (George et al. 1982). *B. c. shermani* is known only from its type locality in Lee County near the west coast of Florida (Layne 1992).

FOSSIL RECORD. *Blarina carolinensis* was 1st known from an early Pleistocene (2–1.6 $\times$ 10^{-6} years ago) fauna in western Florida (Jones et al. 1984; Morgan and White 1995). Fossil and molecular evidence suggest that *B. carolinensis* and *B. brevicauda* share a common ancestor and form a monophyletic group (George 1986; Jones et al. 1984). *Blarina carolinensis* is known from at least 25 Pleistocene and Holocene sites in 9 states (Harris 1998). Tentatively identified material collected in Kansas and South Dakota suggests a widespread distribution for the species during the Pleistocene, perhaps in association with grasslands (Jones et al. 1984).

FORM AND FUNCTION. Dental formula is i 3/1, c 1/1, p 3/1, m 3/3, total 32 (George et al. 1986). Teeth are pigmented with reddish iron deposits (Dötsch and Koenigswald 1978). I1 is falciform with a prominent hook, whereas i1 is procumbent. Remaining incisors and first 3 premolars in upper jaw are unicuspid. The first 2 unicuspids are similar in size and larger than 3rd and 4th unicuspids, which are also similar in size. The 5th unicuspid is minute and may not be seen when viewed laterally. Of 118 *B. carolinensis*, 10 had dental anomalies, primarily missing or displaced P3 (Feldhamer and Stober 1993). In addition, of 354 *B. carolinensis*, 13.6% had subnumerary, supernumerary, displaced, diminutive, or fused teeth (Choate 1968).

Density of hair from *B. carolinensis* did not vary among seasons in eastern Virginia, although guard hairs were 1.3 times longer in winter than in summer (Dew et al. 1998). An albinistic *B. carolinensis* was collected in Gibson County, Tennessee (Smith 1976).

Morphology associated with nonshivering thermogenesis in *B. carolinensis* was documented for eastern Virginia (Dew et al. 1998). Cell volume occupied by mitochondria and maximum size of mitochondria were greater in brown adipose tissue of southern short-tailed shrews collected in winter than in summer, indicating a greater thermogenic potential in winter. Conversely, interscapular lipid droplets were larger and occupied greater cellular volumes in summer than winter, suggesting fat use in winter and fat storage in summer (Dew et al. 1998).

Blarina carolinensis in central Florida had a body temperature of 36.8 $\pm$ 0.1°C (*SE*) when ambient temperature was between 10 and 30°C (McNab 1991). Body temperature increased at ambient temperatures >30°C and decreased at ambient temperatures <10°C. The zone of thermoneutrality for *B. carolinensis* is from 30 to 34°C. Specific metabolism in the zone of thermoneutrality while

individuals were inactive was 3.26 ± 0.06 cm^3 O_2 g^{-1} h^{-1}. Although animals were not postabsorptive during measurements, this rate can be considered basal because feeding did not affect it (McNab 1991). Mean minimal thermal conductance was 0.375 ± 0.009 cm^3 O_2 g^{-1} h^{-1} $°C^{-1}$. Metabolic rate and conductance were sensitive to ambient temperature (McNab 1991).

Average concentrations (parts per million dry weight) of several elements in 16 southern short-tailed shrews from a lowland mesic-hardwood forest in South Carolina were as follows: calcium, 34,700; iron, 500; magnesium, 1,264; potassium, 15,300; sodium, 4,060; and zinc, 116 (Beyers et al. 1971).

ONTOGENY AND REPRODUCTION. On the upper Coastal Plain of South Carolina, male *B. carolinensis* exhibited a bimodal trend in mean testicular length, with peaks occurring in March and September and lows in July and December (O'Farrell et al. 1977). The summer low point was attributed to an influx of young males born in spring, as testes of adult males did not regress in summer. Trends in pregnancy rates followed those for mean testicular length through the year, although peaks were 1 month later. Pregnant females 1st appeared in March, and the latest pregnancy was observed in November. Observations of reproductive activity of *B. carolinensis* for North Carolina (Brimley 1923), Illinois (Hoffmeister 1989; Layne 1958), and Florida (Moore 1946) also fell between March and November. In contrast, a lactating female was captured in southwestern Alabama on 20 December (Linzey 1970), suggesting a longer breeding season at lower latitudes.

Litter size averaged 3.75 (range 2–6; $n = 24$) during March–July and 4.24 (range 3–5; $n = 17$) during September–November in South Carolina (O'Farrell et al. 1977). Overall, average litter size was 3.95 (range 2–6; $n = 41$). This range is consistent with litter sizes for South Carolina (5–6—Audubon and Bachman 1851), North Carolina (3–5—Brimley 1923), and Florida (4—Moore 1946).

Two nests with young were constructed of roots and grass leaves and located ca. 30 cm under the soil surface (Audubon and Bachman 1851). A nest of *B. carolinensis* was found within a rotten log in Arkansas (Easterla 1968).

ECOLOGY. *Blarina carolinensis* lives in diverse terrestrial habitats (Genoways and Choate 1998), including natural and managed pine forests in all seral stages, which cover the majority of its range (Hamilton et al. 1987; Johnson 1987; Labisky and Hovis 1987; Langley and Shure 1980; Perkins et al. 1989; Whiting and Fleet 1987). *B. carolinensis* may be less common in newly regenerated than older pine forests (Mengak et al. 1989; Wolfe and Lohoefener 1983). The southern short-tailed shrew uses a variety of disturbed sites, including strip-mined areas in various stages of reclamation (Urbanek and Klimstra 1986; Verts 1960), abandoned agricultural fields (Briese and Smith 1974; Golley et al. 1965), roadsides (Tate et al. 1980), and large-scale blow-downs caused by tornados (Loeb 1999). It also inhabits brushy areas, cane bottoms, bottomland and upland hardwood forests, and mixed pine-hardwood forests (Calhoun, 1941; Garland and Heidt 1989; Hayden and MacCallum 1976; Kennedy et al. 1974; McCarley and Bradshaw 1953; Schmidley 1983; Wolfe and Esher 1981).

More *B. carolinensis* were caught in mesic hardwood-swamp habitats and fewer in upland hardwood habitats than expected on the Coastal Plain of South Carolina (Gentry et al. 1968, 1971a). Also, *B. carolinensis* was more common in mesic than upland woodlots in Georgia (Parmley and Harley 1995). However in South Carolina, *B. carolinensis* was present equally in dry and moist habitat types (Briese and Smith 1974). *Blarina carolinensis* may be uncommon in areas with saturated soils (Hatchell 1964) because of the lack of suitable nesting locations. In swamps, *B. carolinensis* may nest under and in rotten wood (Goodpaster and Hoffmeister 1952; Howell 1921).

Where *B. carolinensis* and *B. brevicauda* are sympatric in North Carolina and Virginia, *B. carolinensis* may select early-successional habitats, such as grasslands and pine forests, to avoid competition with *B. brevicauda,* which is more common in hardwood forests (Rose 1992; Webster 1996). Conversely, where *B. carolinensis* and *B. hylophaga* are sympatric in Texas, *B. carolinensis* may select moist habitats to avoid competition with *B. hylophaga,* which is more common in dry grasslands (Baumgardner et al. 1992).

Few estimates of population density of the southern short-tailed shrew exist, primarily because of difficulties in live trapping this species. Available estimates are based upon removal studies. Density of *B. carolinensis* in moist hardwood forests of the upper Coastal Plain of South Carolina was estimated at between 1.3 and 2.2 shrews/ha in winter and early spring (Kaufman et al. 1971) and 6.3 shrews/ha in late summer and early autumn (Smith et al. 1971). Calhoun (1941) estimated the density of *B. carolinensis* at 13.2 shrews/ha during late summer in suitable habitats of the Reelfoot Lake Biological Station, Tennessee. However, this may be overestimated because of the movement of animals onto study plots during the sample period (Smith et al. 1971) and because suitable habitats were defined based on the sampling effort.

Methods used to capture *B. carolinensis* have included Museum Special and Victor snap-traps (Briese and Smith 1974), pitfall traps with and without drift fences (Mengak et al. 1989; Whittaker and Feldhamer 2000), and small box traps (Hatchell 1964; Loeb 1999). Pitfall and box traps will trap the southern short-tailed shrew alive; however, frequent checks are necessary to avoid trap mortality (Whittaker and Feldhamer 2000). Box traps described by Whittaker and Feldhamer (2000) were more effective at catching the southern short-tailed shrew than pitfall traps (2.4-l plastic containers—Whittaker and Feldhamer 2000).

Typically, the southern short-tailed shrew is more abundant than other shrews with which it is commonly found, including *Cryptotis parva* and *Sorex longirostris* (Garland and Heidt 1989; Gerard and Feldhamer 1990). It was the most common small mammal in several habitats in South Carolina (Gentry et al. 1968, 1971b; Smith et al. 1971, 1974). *B. carolinensis* is most often syntopic with *Peromyscus gossypinus, P. leucopus,* and *Ochrotomys nuttali,* which often exceed *B. carolinensis* in abundance (Faust et al. 1971; Hatchell 1964; Kaufman et al. 1971; Rose and Seegert 1982).

The southern short-tailed shrew exhibits a strong annual fluctuation in abundance, with peaks during the late spring and autumn (Briese and Smith 1974). Because reproduction is not evenly distributed throughout the year (O'Farrell et al. 1977), population size will reflect recruitment of juveniles following spring and autumn reproductive efforts.

Drastic changes in abundance among years at the same site have been documented in South Carolina (Gentry et al. 1971a; Smith et al. 1974). Relative abundance of *B. carolinensis,* along with that of several other small mammals, decreased between 1967 and 1970 (Gentry et al. 1971a) and increased during 1971–1972 (Smith et al. 1974). Precipitation during the previous summer was most closely correlated with changes in abundance, perhaps because it led to greater abundance of invertebrate prey (Smith et al. 1974). The decline during 1967–1970 was attributed to extended drought.

Primary foods by volume of 45 *B. carolinensis* in bottomland hardwood forests of the upper Coastal Plain of South Carolina were slugs and snails (18.5%), hypogeous fungi in the genus *Endogone* and related genera (16.3%), earthworms (14.8%), adult beetles (9.6%), and beetle larvae (5.8%—Whitaker et al. 1994). Total volumes of Coleoptera, Lepidoptera, and Diptera were 17.8, 6.0, and 6.7%, respectively. Primary foods by volume of 13 *B. carolinensis* collected in a xeric pine forest in the same region were centipedes (22.3%), hypogeous fungi (14.6%), fly larvae (12.3%), spiders (10.0%), and adult flies (8.1%—McCay 1998). In northwestern Tennessee, adult and larval beetles, ants, and slugs were found most commonly in diets of short-tailed shrews (Calhoun 1941). Incidental dietary accounts have revealed caterpillars (Rand and Host 1942) and turtle eggs (Dietz and Jackson 1979) as elements of the *B. carolinensis* diet in Florida.

Predators of *B. carolinensis* include owls, *Asio flammeus, A. otus, Otus asio,* and *Tyto alba* (Adams et al. 1986; Birkenholz 1958; Chicardi et al. 1990; Dusi 1957; Feldhamer 1985; Feldhamer et al. 1987; Hanebrink et al. 1979; Lavers 1990; Miller 1994; Paige et al. 1979; Parmalee 1954; Smith and Hanebrink 1982; Steward et al. 1988; Tedards 1963; Trost and Hutchison 1964; Westmoreland et al. 1994; Wolfe and Rogers 1969); hawks, *Accipiter cooperii* and *Buteo jamaicensis* (Hanebrink et al. 1979); snakes, *Agkistrodon contortrix, A. piscivorous, Elaphe obsoleta,* and *Masticophis flagellum* (Brown 1979; Hamilton and Pollack 1956; Kofron 1978); coyote, *Canis latrans* (Gipson 1974; Michaelson and Goertz 1977); and red fox, *Vulpes vulpes* (Knable 1970). *B. carolinensis* also was recovered from the stomach of a green sunfish, *Lepomis cyanellus* (Huish and Hoffmeister 1947).

Forty-four of 46 *B. carolinensis* near Raleigh, North Carolina, and 13 of 20 *B. carolinensis* from southern Illinois were infected with flukes (Trematoda: *Brachylaima dolichodirus, B. thompsoni, Brachylecithum, Panopistus pricei*), tapeworms (Cestoda: *Cryptocotylepis anthocephalus*), round worms (Nematoda: *Capillaria plica, Longistriata caudabullata, Physaloptera, Porrocaecum ensicaudatum*), or thorny-headed worms (Acanthocephala: *Centrorhynchus*—Barker et al. 1987; Miller et al. 1974).

At least 43 species of ectoparasites and associates are known from *B. carolinensis* (Pascal 1984; Whitaker et al. 1994). The following mites have been collected from the southern short-tailed shrew: *Androlaelaps fahrenholzi, A. casalis, Asiochirus blarina, Bakerdania plurisetosa, Blarinobia simplex, Comatacarus americanus, Cyrtolaelaps, Echinonyssus blarinae, Eucheyletia bishoppi, Eulaelaps stabularis, Euryparasitus, Euschoengastia ohioensis, E. setosa, Glycyphagus hypudaei, Haemogamasus liponyssoides, H. longitarsus, Histiostoma, Hypoaspis, Myonyssus jamesoni, Orycteroxenus soricis, Proctolaelaps, Protomyobia americana, P. blarinae, Prowichmannia spinifera, Pygmephorus equitrichosus, P. hamiltoni, P. hastatus, P. horridus, P. johnstoni, P. moreohorridus, P. scalopi, P. tamiasi, P. whartoni, P. whitakeri, P. wrenschae, Scutacarus, Xenoryctes latiporus,* and *X. nudus.* Three fleas (*Ctenophthalmus pseudagyrtes, Doratopsylla blarinae,* and *Stenoponia americana*), 1 tick (*Dermacentor variabilis*), and 1 beetle (*Leptinus americanus*) also have been found on *B. carolinensis* (Pascal 1984; Whitaker et al. 1994). Genoways and Choate (1998) highlight several ectoparasites incorrectly attributed to *B. carolinensis* by other authors. Twenty-four southern short-tailed shrews from southern Illinois tested negative for rabies (Pearson and Barr 1962).

BEHAVIOR. *Blarina carolinensis* was more readily captured during late spring and autumn than summer or winter in an old field in South Carolina (Briese and Smith 1974). Increased capture rates during spring and autumn may have been due to behaviors associated with breeding (O'Farrell et al. 1977) or decreased use of burrows during periods of mild weather (Genoways and Choate 1998).

Using radioactively tagged peanut butter, conservative estimates of movement distances for *B. carolinensis* were 20.3 ± 2.8 m on a 14.1-ha trapping grid in a lowland mesic-hardwood forest in South Carolina (Gentry et al. 1971b). In the same area, average distance between subsequent live captures of *B. carolinensis* (n = 7) was 94.7 ± 30.8 m, with a noteworthy maximum distance of 603.7 m (Faust et al. 1971). Average home range size was 0.959 ha (n = 7, both sexes), as determined by the minimum area method (Faust et al. 1971).

GENETICS. Throughout most of its distribution *B. carolinensis* apparently exhibits little chromosomal variation, with 2n = 46 and FN = 44–45 (George et al. 1982). *B. carolinensis* collected in western Tennessee and northern Mississippi, however, have been found with 2n = 31–41 and FN = 41–45 (Beck et al. 1991; Elrod et al. 1996; George et al. 1982; Qumsiyeh et al. 1997, 1999). Chromosomal variation in this region is due to Robertsonian translocations (Elrod et al. 1996; Qumsiyeh et al. 1997, 1999). Fifteen individuals of *B. c. peninsulae* demonstrated a markedly different karyotype than other *B. carolinensis*, with 2n = 50–52 and FN = 52 (George et al. 1982).

Each of the following 12 loci examined by Tolliver et al. (1985) was monomorphic in 30 *B. carolinensis* examined from the upper Coastal Plain of South Carolina: albumin, glucose-6-phosphate dehydrogenase, superoxide dismutase, isocitrate dehydrogenase-1, lactate dehydrogenase-1 and -2, malate dehydrogenase-1 and -2, phosphoglucomutase-1 and -2, phosphogluconate dehydrogenase, and sorbital dehydrogenase. A more extensive study (n = 51) at the same location revealed polymorphism at 11 of 28 loci (Tolliver and Robbins 1987). Polymorphic loci included adenoside deaminase, aspartate aminotransferase-1 and -2, creatine kinase, glucose phosphate isomerase, glutamate dehydrogenase-2, isocitrate dehydrogenase-2, malic enzyme, nucleoside phosphorylase, peptidase-2, and phosphoglucomutase-3. Monomorphic loci included the 12 examined by Tolliver et al. (1985), as well as adenylate kinase, aldolase, glutamate dehydrogenase-1, mannose phosphate isomerase, and peptidase-1 (Tolliver and Robbins 1987).

Each of the following loci was monomorphic in a population of *B. carolinensis* from southern Illinois (n = 58—Driskell 1992): adenylate kinase, aspartate aminotransferase-1 and -2, creatine kinase, dipeptidase, fructose bisphosphate aldolase-1 and -2, glucose dehydrogenase, glucose-6-phosphate dehydrogenase, isocitrate dehydrogenase-1 and -2, L-lactate dehydrogenase-1 and -2, malate dehydrogenase-1 and -2, malic enzyme, mannose-6-phosphate isomerase, peptidase-c, phosphoglucomutase, phosphogluconate dehydrogenase, purine nucleoside phosphorylase, sorbitol dehydrogenase, superoxide dismutase-1 and -2, and tripeptide aminopeptidase. Esterase and proline dipeptidase were polymorphic (Driskell 1992). Mean allelic heterozygosity ranged from 2.8% to 3.3% (Driskell 1992; Tolliver and Robbins 1987).

REMARKS. The generic name *Blarina* has no known basis; J. E. Gray introduced the term in 1838 (Gotch 1979). The specific epithet *carolinensis* means "belonging to Carolina" and refers to the place where this animal was 1st collected. This species is less commonly known as the Carolina shrew.

Blarina carolinensis was until recently (Genoways and Choate 1972) considered a subspecies of *B. brevicauda.* Thus, data for *B. carolinensis* prior to separation of these taxa were typically published under *B. brevicauda.* Data were only included in this account if evidence clearly indicated that specimens were collected or observed within the modern range of *B. carolinensis.* Genoways and Choate (1998) provided a valuable aid in these determinations.

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